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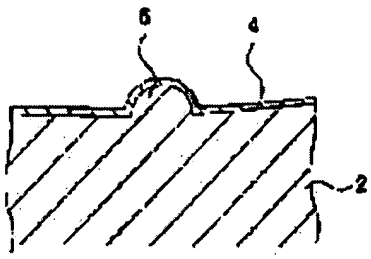
(54) METAL MOLD FOR MOLDING GOLF BALL

(57)Abstract:
PROBLEM TO BE SOLVED: To improve mold releasing property, wear resistance, and corrosion resistance of a metal mold for molding a golf ball to be used for molding a golf ball or a core of golf ball.
SOLUTION: A coating film 4 consisting of an amorphous carbon hard film, i.e., amorphous diamond-like carbon is formed on a cavity surface of a metal mold body 2 for molding a golf ball. The coating film 4 consisting of the amorphous carbon hard film is of high hardness and excellent in surface smoothness, wear resistance, and chemical stability, and in addition, a low friction coefficient and has a lubricating effect. Consequently, by forming such amorphous carbon hard coating film 4 on the cavity surface, excellent mold releasing property, wear resistance and corrosion resistance can be obtained.



LEGAL STATUS

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CLAIMS

[Claim(s)]
[Claim 1] The golf ball molding die characterized by forming in the mold cavity front face of a golf ball molding-die body the coat which consists of amorphous carbon hard film.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] When this invention is further explained in full detail about the golf ball molding die used for shaping of the core for a golf ball or golf balls, it relates to the golf ball molding die in which the coat for improvement in unmolding nature, abrasion resistance, and corrosion resistance was formed on the mold cavity front face.
[0002]
[Description of the Prior Art] Since the bad resin of unmolding nature is used by the former in shaping of the golf ball by compression molding or injection molding, or the core for golf balls, it is the purpose which cannot unmold the fabricated golf ball or core easily from metal mold, therefore gives unmolding nature to metal mold or the mold goods itself, and the approach shown below is taken from it.
(1) How to carry out the spray of the release agents, such as silicon oil, to the mold cavity front face of metal mold.
(2) The approach of presenting shaping by metal mold, after carrying out dipping of the release agent to the preforming article of a golf ball.
(3) The approach of scouring a release agent to a golf ball or the molding resin of a core, and presenting shaping.
[0003]
[Problem(s) to be Solved by the Invention] However, there are the respectively following troubles in the above-mentioned approach. namely, the approach of (1) -- (**) -- (**) which a release agent is involved in into the resin of mold goods during shaping, and a defective may generate -- whenever it fabricates once (Ha), the spray of the release agent must be carried out to metal mold, and it has the fault which will need to carry out washing removal of the release agent adhering to a mold-goods front face after shaping that a fabrication operation is complicated. When processes before shaping, such as a process which manufactures a preforming article before shaping, and a process which carries out dipping of the release agent to this, increase, it will be necessary to carry out washing removal of the release agent which adhered to the shaping postforming article front face like the approach of (1), and by the approach of (2), a production process makes it complicated. By the approach of (3), unmolding nature sufficient by just scouring a release agent for the interior of resin is not obtained, but other unmolding nature grant means, such as carrying out the spray of the release agent to metal mold after all, must be provided.
[0004] On the other hand, forming various coats in the mold cavity front face of metal mold for the purpose which raises unmolding nature is proposed. as the example, it is shown in the following ** - ** -- it is.
** Form the layer of Ti compounds, such as TiN and TiC, in a mold cavity front face (JP,59-179311,A).

** Form a chromic-acid-ized coat in a mold cavity front face, and coat a fluororesin on this coat (JP,5-23403,A).
** Form in a mold cavity front face the nickel-plating layer which deposited the fluorine system

macromolecule particle (JP,5-220241,A).
** While forming a chrome plating layer in a mold cavity front face, infiltrate a fluorine system macromolecule particle into the crack section of the front face of this chrome plating layer (JP,5-228227,A).
However, neither of the metal mold, the above-mentioned ** nor - **, was what fully satisfies unmolding nature, abrasion resistance, and corrosion resistance to coincidence.
[0005] This invention was made in view of the above-mentioned situation, and aims at offering unmolding nature, abrasion resistance, and the golf ball molding die excellent in corrosion resistance all.

[0006]
[Means for Solving the Problem] This invention offers the golf ball molding die characterized by forming in the mold cavity front face of a golf ball molding-die body the coat which consists of amorphous carbon hard film in order to attain the above-mentioned purpose.
[0007] The coat which consists of amorphous carbon hard film is a high degree of hardness, when excelled in surface smooth nature, abrasion resistance, and chemical stability, its coefficient of friction is small, and it has the lubrication effectiveness. Therefore, the metal mold of this invention in which the amorphous carbon hard film to apply was formed on the mold cavity front face shows the outstanding unmolding nature, abrasion resistance, and corrosion resistance.
[0008] The golf ball molding die of this invention forms in the mold cavity front face of the body 2 of metal mold the coat 4 which consists of amorphous carbon hard film, as shown in drawing 1 . In addition, six in drawing is the heights for dimple formation formed in the mold cavity of metal mold.
[0009] As a body 2 of metal mold, anythings, such as iron formed by electroforming, the high pre JISHON method, casting, etc., a product made from a copper alloy, a product made from stainless steel, a product made from nickel, and a product made from zinc dies casting, can be used. Moreover, in order to form in the mold cavity front face of the body 2 of metal mold the coat 4 which consists of amorphous carbon hard film good, pretreatment of arbitration, substrate formation, etc. can be performed.
[0010] In this invention, the amorphous carbon hard film means the film which consists of diamond-like carbon (it omits Following DLC). It is the amorphous hard carbon film whose DLC film is not crystallinity to the diamond film being crystalline hard carbon film. Although the DLC film is inferior to the diamond film in respect of a degree of hardness, it excels the diamond film in smooth nature and lubricity. In addition, although the DLC film also has the case of only amorphous structure, it may consist of amorphous structure and diamond structure. The DLC film usually forms the alloy with hydrogen in presentation, and hydrogen concentration is 0 - 40at.% extent. Moreover, as the electronic structure, the carbon in the DLC film is mainly combined by sp3.
[0011]
[Embodiment of the Invention] In this invention, what has the following property is mentioned, for example as amorphous carbon hard film (DLC film) formed in a mold cavity front face.
crystal structure: -- amorphous -- coupling-case:sp3 subject consistency: -- three (g/cm3) or less
Micro Vickers hardness (load 10gf): 2000-5000 (kgf/mm2)
content hydrogen concentration: -- 0 - 40at.% morphology: -- very smooth -- [0012] The dry process of the CVD method or vacuum deposition using the plasma-CVD method using glow discharge, the ion plating method or the sputtering method, the vacuum deposition using an ion beam or the sputtering method, and laser can perform formation of the amorphous carbon hard film on a mold cavity front face by using the gas containing carbon, such as a hydrocarbon, alcohol, an acetone, a carbon monoxide, and a carbon dioxide, solid graphite (graphite), etc. as the main raw material.
[0013] For example, it is the approach of plasma CVD making the plasma state the introduced reactant gas, making generate activity radical and ion, making perform a chemical reaction under an activity environment, and forming a thin film on a substrate (metal mold) at low temperature, and a pressure is about 1-100Pa. In this case, the plasma used for plasma CVD can be generated by a direct current (DC), the RF (RF), or microwave discharge.

[0014] When forming the amorphous carbon hard film in a mold cavity front face, membranes are formed controlling the various parameters which affect a membranous property. For example, in RF plasma CVD, as a parameter which affects a membranous property, RF power, substrate bias, gas supply volume, exhaust velocity, gas pressure, the energy of ion, substrate temperature, etc. are mentioned, and the amorphous carbon hard film of a desired property can be obtained by forming membranes, controlling these parameters.
[0015] Especially although there is especially no limitation in the thickness of the amorphous carbon hard film formed in a mold cavity front face, 0.001-20 micrometers of things set to 1-5 micrometers are suitable. When thinner than 0.001 micrometers, unmolding nature (mold-release characteristic) may worsen, and the endurance of the hard film may be missing. If thicker than 20 micrometers, it will become easy to produce a crack with the internal stress of the hard film.
[0016] The golf ball molding die of this invention is used for manufacture of the core for a golf ball or golf balls, i.e., covering of covering of a two-piece ball or a three-piece ball, manufacture of the core of a two-piece ball or a one-piece ball, manufacture of the solid core of a three-piece ball, etc., and can be used for both compression molding and injection molding.
[0017]
[Example] Next, although an example shows this invention concretely, this invention is not limited to the following example.
[0018] The golf ball molding-die body made from nickel was manufactured with electroforming, the amorphous carbon hard film (DLC film) was formed in the mold cavity front face of this body of metal mold with the CVD method, and the golf ball molding die of this invention was obtained. The contents of CVD and the description of the obtained amorphous carbon hard film, and a property are shown below.
[0019] The mixed gas of CVD methane and hydrogen was made into material gas, and membranes were formed with the CVD method. Substrate (metal mold) temperature was made into 200 degrees C.
[0020] The description of the amorphous carbon hard film, a property crystal-structure:amorphous thickness:3 micrometer consistency: About 2.0 (g/cm3)
Dynamic friction coefficient muk (load 20gf) k (load 100gf)::0.03 dynamic-friction-coefficient mu0.14 coefficient-of-static-friction mus (load 20gf) :0.12 coefficient-of-static-friction mus(load 100gf):0.31 micro Vickers hardness (load 10gf): 1800 (kgf/mm2)
Abrasion resistance: As a result of performing a SUGA abrasion test in load 800gf, using SiC#600 as the abrasive paper, the abrasion loss of the amorphous carbon hard film was about 56% of TiN about 23% of nickel-Cr plating about 16% of SUS304.
morphology: -- very smooth -- chemical-resistant:acid, alkali, and an organic solvent -- insoluble color: -- black [0021] The following shaping was performed using the golf ball molding die of this invention produced as mentioned above.
(a) Covering which uses ionomer resin as a principal component with compression molding at a core was covered, and the two-piece ball was manufactured.
(b) Covering which uses ionomer resin as a principal component with injection molding at a core was covered, and the two-piece ball was manufactured.
(c) Covering which uses balata as a principal component with compression molding at a core was covered, and the three-piece ball was manufactured.
(d) The core of the two-piece ball which uses polybutadiene rubber as a principal component with injection molding was manufactured.
(e) The solid core of the three-piece ball which uses polybutadiene rubber as a principal component with injection molding was manufactured.
[0022] Consequently, unmolding nature good in any case was shown. Moreover, after repeating shaping about 100 times, when the condition of the amorphous carbon hard film on the front face of a mold cavity was investigated, neither wear nor corrosion was produced but it was checked that the abrasion resistance of the amorphous carbon hard film and corrosion resistance are good.
[0023]

[Effect of the Invention] As explained above, the golf ball molding die of this invention is excellent in unmolding nature, abrasion resistance, and corrosion resistance all. Therefore, whenever it fabricates, it is not necessary to carry out the spray of the release agent or, and it is not necessary to scour an internal release agent to shaping resin, and, according to the metal mold of this invention, there is also no need that a golf ball is washed and a release agent is removed after shaping. Moreover, since it excels in the abrasion resistance of a mold cavity side, and corrosion resistance, metal mold can be used, without maintaining over a long period of time.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] When this invention is further explained in full detail about the golf ball molding die used for shaping of the core for a golf ball or golf balls, it relates to the golf ball molding die in which the coat for improvement in unmolding nature, abrasion resistance, and corrosion resistance was formed on the mold cavity front face.

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PRIOR ART

[Description of the Prior Art] Since the bad resin of unmolding nature is used by the former in shaping of the golf ball by compression molding or injection molding, or the core for golf balls, it is the purpose which cannot unmold the fabricated golf ball or core easily from metal mold, therefore gives unmolding nature to metal mold or the mold goods itself, and the approach shown below is taken from it.
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EFFECT OF THE INVENTION

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TECHNICAL PROBLEM

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MEANS

[Means for Solving the Problem] This invention offers the golf ball molding die characterized by forming in the mold cavity front face of a golf ball molding-die body the coat which consists of amorphous carbon hard film in order to attain the above-mentioned purpose.
[0007] The coat which consists of amorphous carbon hard film is a high degree of hardness, when excelled in surface smooth nature, abrasion resistance, and chemical stability, its coefficient of friction is small, and it has the lubrication effectiveness. Therefore, the metal mold of this invention in which the amorphous carbon hard film to apply was formed on the mold cavity front face shows the outstanding unmolding nature, abrasion resistance, and corrosion resistance.
[0008] The golf ball molding die of this invention forms in the mold cavity front face of the body 2 of metal mold the coat 4 which consists of amorphous carbon hard film, as shown in drawing 1 . In addition, six in drawing is the heights for dimple formation formed in the mold cavity of metal mold.
[0009] As a body 2 of metal mold, anythings, such as iron formed by electroforming, the high pre JISHON method, casting, etc., a product made from a copper alloy, a product made from stainless steel, a product made from nickel, and a product made from zinc dies casting, can be used. Moreover, in order to form in the mold cavity front face of the body 2 of metal mold the coat 4 which consists of amorphous carbon hard film good, pretreatment of arbitration, substrate formation, etc. can be performed.
[0010] In this invention, the amorphous carbon hard film means the film which consists of diamond-like carbon (it omits Following DLC). It is the amorphous hard carbon film whose DLC film is not crystallinity to the diamond film being crystalline hard carbon film. Although the DLC film is inferior to the diamond film in respect of a degree of hardness, it excels the diamond film in smooth nature and lubricity. In addition, although the DLC film also has the case of only amorphous structure, it may consist of amorphous structure and diamond structure. The DLC film usually forms the alloy with hydrogen in presentation, and hydrogen concentration is 0 - 40at.% extent. Moreover, as the electronic structure, the carbon in the DLC film is mainly combined by sp3.
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Micro Vickers hardness (load 10gf): 2000-5000 (kgf/mm2)
content hydrogen concentration: -- 0 - 40at.% morphology: -- very smooth -- [0012] The dry process of the CVD method or vacuum deposition using the plasma-CVD method using glow discharge, the ion plating method or the sputtering method, the vacuum deposition using an ion beam or the sputtering method, and laser can perform formation of the amorphous carbon hard film on a mold cavity front face by using the gas containing carbon, such as a hydrocarbon, alcohol, an acetone, a carbon monoxide, and a carbon dioxide, solid graphite (graphite), etc. as the main raw material.
[0013] For example, it is the approach of plasma CVD making the plasma state the introduced reactant gas, making generate activity radical and ion, making perform a chemical reaction under an activity

environment, and forming a thin film on a substrate (metal mold) at low temperature, and a pressure is about 1-100Pa. In this case, the plasma used for plasma CVD can be generated by a direct current (DC), the RF (RF), or microwave discharge.

[0014] When forming the amorphous carbon hard film in a mold cavity front face, membranes are formed controlling the various parameters which affect a membranous property. For example, in RF plasma CVD, as a parameter which affects a membranous property, RF power, substrate bias, gas supply volume, exhaust velocity, gas pressure, the energy of ion, substrate temperature, etc. are mentioned, and the amorphous carbon hard film of a desired property can be obtained by forming membranes, controlling these parameters.

[0015] Especially although there is especially no limitation in the thickness of the amorphous carbon hard film formed in a mold cavity front face, 0.001-20 micrometers of things set to 1-5 micrometers are suitable. When thinner than 0.001 micrometers, unmolding nature (mold-release characteristic) may worsen, and the endurance of the hard film may be missing. If thicker than 20 micrometers, it will become easy to produce a crack with the internal stress of the hard film.

[0016] The golf ball molding die of this invention is used for manufacture of the core for a golf ball or golf balls, i.e., covering of covering of a two-piece ball or a three-piece ball, manufacture of the core of a two-piece ball or a one-piece ball, manufacture of the solid core of a three-piece ball, etc., and can be used for both compression molding and injection molding.

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EXAMPLE

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Abrasion resistance: As a result of performing a SUGA abrasion test in load 800gf, using SiC#600 as the abrasive paper, the abrasion loss of the amorphous carbon hard film was about 56% of TiN about 23% of nickel-Cr plating about 16% of SUS304.
morphology: -- very smooth -- chemical-resistant:acid, alkali, and an organic solvent -- insoluble color: -- black [0021] The following shaping was performed using the golf ball molding die of this invention produced as mentioned above.
(a) Covering which uses ionomer resin as a principal component with compression molding at a core was covered, and the two-piece ball was manufactured.
(b) Covering which uses ionomer resin as a principal component with injection molding at a core was covered, and the two-piece ball was manufactured.
(c) Covering which uses balata as a principal component with compression molding at a core was covered, and the three-piece ball was manufactured.
(d) The core of the two-piece ball which uses polybutadiene rubber as a principal component with injection molding was manufactured.
(e) The solid core of the three-piece ball which uses polybutadiene rubber as a principal component with injection molding was manufactured.
[0022] Consequently, unmolding nature good in any case was shown. Moreover, after repeating shaping about 100 times, when the condition of the amorphous carbon hard film on the front face of a mold cavity was investigated, neither wear nor corrosion was produced but it was checked that the abrasion resistance of the amorphous carbon hard film and corrosion resistance are good.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the partial expanded sectional view showing one example of the golf ball molding die concerning this invention.
[Description of Notations]
2 Body of Metal Mold
4 Coat Which Consists of Amorphous Carbon Hard Film
6 Heights for Dimple Formation

[Translation done.]

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特開平9－47525

(43)公開日　平成９年(1997)２月18日

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Ｂ２９Ｃ　33/38		9543－4Ｆ	Ｂ２９Ｃ　33/38		
33/44		9543－4Ｆ	33/44		
Ｂ２９Ｄ　31/00		7726－4Ｆ	Ｂ２９Ｄ　31/00		

審査請求　未請求　請求項の数１　ＦＤ　（全　４　頁）

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(71)出願人　592014104
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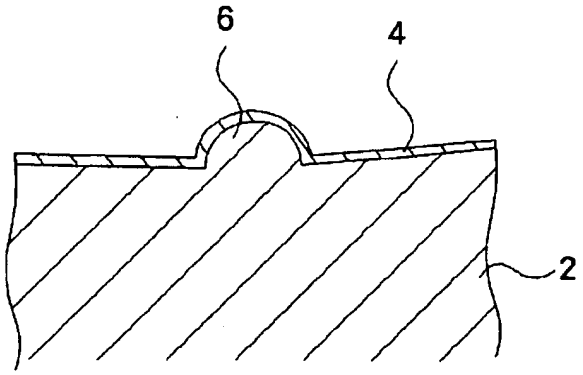
最終頁に続く

(54)【発明の名称】　ゴルフボール成形用金型

(57)【要約】

【課題】　ゴルフボールあるいはゴルフボール用コアの成形に用いられるゴルフボール成形用金型の脱型性、耐摩耗性、耐食性を向上させる。

【解決手段】　ゴルフボール成形用金型本体２のキャビティー表面に、アモルファスカーボン硬質膜、すなわち非晶質のダイヤモンド・ライク・カーボンからなる皮膜４を形成する。アモルファスカーボン硬質膜からなる皮膜４は、高硬度で、表面平滑性、耐摩耗性、化学的安定性に優れている上、摩擦係数が小さく、かつ潤滑効果を有する。したがって、かかるアモルファスカーボン硬質膜４をキャビティー表面に形成することにより、優れた脱型性、耐摩耗性、耐食性が得られる。



【特許請求の範囲】
【請求項１】　ゴルフボール成形用金型本体のキャビティー表面に、アモルファスカーボン硬質膜からなる皮膜が形成されていることを特徴とするゴルフボール成形用金型。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、ゴルフボールあるいはゴルフボール用コアの成形に用いられるゴルフボール成形用金型に関し、さらに詳述すると、キャビティー表面に脱型性、耐摩耗性、耐食性の向上のための皮膜を形成したゴルフボール成形用金型に関する。
【０００２】
【従来の技術】従来より、圧縮成型や射出成型によるゴルフボールあるいはゴルフボール用コアの成形においては、脱型性の悪い樹脂が用いられるため、成形したゴルフボールあるいはコアを金型から容易に脱型することができず、そのため金型又は成形品自身に脱型性を付与する目的で、以下に示す方法が採られている。
（１）金型のキャビティー表面にシリコーン油等の離型剤をスプレーする方法。
（２）ゴルフボールの予備成形品に離型剤をディッピングした後、金型による成形に供する方法。
（３）ゴルフボールあるいはコアの成形用樹脂に離型剤を練り込み、成形に供する方法。
【０００３】
【発明が解決しようとする課題】しかし、上記方法には、それぞれ次のような問題点がある。すなわち、
（１）の方法は、(イ)成形中に離型剤が成形品の樹脂中に巻き込まれ、不良品が発生することがある、(ロ)成形後、成形品表面に付着した離型剤を洗浄除去する必要が生じる、(ハ)１回成形する毎に金型に離型剤をスプレーしなければならず、成形作業が煩雑である、という欠点を有している。（２）の方法では、成形前に予備成形品を製造する工程、これに離型剤をディッピングする工程など、成形前の工程が多くなる上、（１）の方法と同様に成形後成形品表面に付着した離型剤を洗浄除去する必要が生じ、製造工程が煩雑化する。（３）の方法では、樹脂内部に離型剤を練り込むだけでは十分な脱型性が得られず、結局金型へ離型剤をスプレーする等の他の脱型性付与手段を講じなければならない。
【０００４】これに対し、脱型性を向上させる目的で、金型のキャビティー表面に種々の皮膜を形成することが提案されている。その具体例としては、下記①～④に示すものある。
①キャビティー表面にＴｉＮ、ＴｉＣ等のＴｉ化合物の層を形成する（特開昭５９－１７９３１１号）。
②キャビティー表面にクロム酸化皮膜を形成し、該皮膜上にフッ素樹脂をコーティングする（特開平５－２３４０３号）。
③キャビティー表面にフッ素系高分子微粒子を析出させたニッケルメッキ層を形成する（特開平５－２２０２４１号）。
④キャビティー表面にクロムメッキ層を形成するとともに、該クロムメッキ層の表面のクラック部にフッ素系高分子微粒子を含浸させる（特開平５－２２８２２７号）。
しかし、上記①～④のいずれの金型も、脱型性、耐摩耗性及び耐食性を同時に十分に満足させるものではなかった。
【０００５】本発明は、上記事情に鑑みてなされたもので、脱型性、耐摩耗性、耐食性のいずれにも優れたゴルフボール成形用金型を提供することを目的とする。
【０００６】
【課題を解決するための手段】本発明は、上記目的を達成するため、ゴルフボール成形用金型本体のキャビティー表面に、アモルファスカーボン硬質膜からなる皮膜が形成されていることを特徴とするゴルフボール成形用金型を提供する。
【０００７】アモルファスカーボン硬質膜からなる皮膜は、高硬度で、表面平滑性、耐摩耗性、化学的安定性に優れている上、摩擦係数が小さく、かつ潤滑効果を有する。したがって、かかるアモルファスカーボン硬質膜をキャビティー表面に形成した本発明の金型は、優れた脱型性、耐摩耗性、耐食性を示す。
【０００８】本発明のゴルフボール成形用金型は、図１に示したように、金型本体２のキャビティー表面に、アモルファスカーボン硬質膜からなる皮膜４を形成したものである。なお、図中６は金型のキャビティーに形成されたディンプル形成用の凸部である。
【０００９】金型本体２としては、電鋳法、ハイプレジション法、鋳造法等により形成された鉄製、銅合金製、ステンレススチール製、ニッケル製、亜鉛ダイキャスト製などのいずれのものでも使用することができる。また、金型本体２のキャビティー表面には、アモルファスカーボン硬質膜からなる皮膜４を良好に形成するために、任意の前処理、下地形成等を行うことができる。
【００１０】本発明において、アモルファスカーボン硬質膜とは、ダイヤモンド・ライク・カーボン（以下ＤＬＣと略す）からなる膜をいう。ダイアモンド膜が結晶性の硬質カーボン膜であるのに対し、ＤＬＣ膜は結晶性でない非晶質の硬質カーボン膜である。ＤＬＣ膜は、硬度の点ではダイヤモンド膜より劣るが、平滑性、潤滑性ではダイヤモンド膜より優れている。なお、ＤＬＣ膜はアモルファス構造のみの場合もあるが、アモルファス構造とダイヤモンド構造とからなる場合もある。ＤＬＣ膜は、組成的には通常、水素との合金を形成しており、水素濃度は０～４０at.％程度である。また、電子構造としては、ＤＬＣ膜中の炭素はsp^3で主として結合している。

【００１１】
【発明の実施の形態】本発明において、キャビティー表面に形成するアモルファスカーボン硬質膜（ＤＬＣ膜）としては、例えば、下記特性を有するものが挙げられる。
結晶構造：非晶質
結合形式：ｓｐ^{3}主体
密度：３以下（g/cm^3）
マイクロビッカース硬さ（荷重１０gf）：２０００～５０００（kgf/mm^2）
含有水素濃度：０～４０at.％
モフォロジー：非常に滑らか
【００１２】キャビティー表面へのアモルファスカーボン硬質膜の形成は、炭化水素、アルコール、アセトン、一酸化炭素、二酸化炭素等の炭素を含むガスや、固体のグラファイト（黒鉛）等を主原料として、グロー放電を用いたプラズマＣＶＤ法、イオンプレーティング法又はスパッタリング法、イオンビームを用いた蒸着法又はスパッタリング法、レーザを用いたＣＶＤ法又は蒸着法といったドライプロセスによって行うことができる。
【００１３】例えば、プラズマＣＶＤは、導入した反応ガスをプラズマ状態にし、活性なラジカルやイオンを生成させ、活性環境下で化学反応を行わせ、低温で基板（金型）上に薄膜を形成する方法であり、圧力は１～１００Ｐａ程度である。この場合、プラズマＣＶＤに用いられるプラズマは、直流（ＤＣ）、高周波（ＲＦ）又はマイクロ波放電によって発生させることができる。
【００１４】キャビティー表面にアモルファスカーボン硬質膜を形成する場合、膜の性質に影響を与える種々のパラメータを制御しつつ成膜を行う。例えば、高周波プラズマＣＶＤでは、膜の性質に影響を与えるパラメータとして、ＲＦ電力、基板バイアス、ガス供給量、排気速度、ガス圧、イオンのエネルギー、基板温度等が挙げられ、これらのパラメータを制御しつつ成膜を行うことにより、所望の性質のアモルファスカーボン硬質膜を得ることができる。
【００１５】キャビティー表面に形成するアモルファスカーボン硬質膜の厚さに特に限定はないが、０．００１～２０μｍ、特に１～５μｍとすることが適当である。０．００１μｍより薄いと、脱型性（離型性）が悪くなり、また硬質膜の耐久性に欠けることがある。２０μｍより厚いと、硬質膜の内部応力によりクラックが生じやすくなる。
【００１６】本発明のゴルフボール成形用金型は、ゴルフボールあるいはゴルフボール用コアの製造、すなわちツーピースボールや糸巻きボールのカバーの被覆、ツーピースボールやワンピースボールのコアの製造、糸巻きボールのソリッドコアの製造などに使用されるもので、圧縮成形、射出成形のいずれにも使用することができる。
【００１７】
【実施例】次に、実施例によって本発明を具体的に示すが、本発明は下記実施例に限定されるものではない。
【００１８】電鋳法によりニッケル製のゴルフボール成形用金型本体を製造し、この金型本体のキャビティー表面にＣＶＤ法によりアモルファスカーボン硬質膜（ＤＬＣ膜）を形成して、本発明のゴルフボール成形用金型を得た。ＣＶＤの内容及び得られたアモルファスカーボン硬質膜の性状、特性を下記に示す。
【００１９】ＣＶＤ
メタンと水素との混合ガスを原料ガスとし、ＣＶＤ法によって成膜を行った。基板（金型）温度は２００℃とした。
【００２０】アモルファスカーボン硬質膜の性状、特性
結晶構造：非晶質
膜厚：３μｍ
密度：約２．０（g/cm^3）
動摩擦係数μ_k（荷重２０gf）　：０．０３
動摩擦係数μ_k（荷重１００gf）：０．１４
静摩擦係数μ_s（荷重２０gf）　：０．１２
静摩擦係数μ_s（荷重１００gf）：０．３１
マイクロビッカース硬さ（荷重１０gf）：１８００（kgf/mm^2）
耐摩耗性：研摩紙としてSiC#６００を用い、荷重８００gfにてスガ摩耗試験を行った結果、アモルファスカーボン硬質膜の摩耗量は、ＳＵＳ３０４の約１６％、Ｎｉ－Ｃｒメッキの約２３％、ＴｉＮの約５６％であった。
モフォロジー：非常に滑らか
耐薬品性：酸、アルカリ、有機溶媒に不溶
色：黒色
【００２１】上記のようにして作製した本発明のゴルフボール成形用金型を用い、下記の成形を行った。
(a)圧縮成形によりコアにアイオノマー樹脂を主成分とするカバーを被覆してツーピースボールを製造した。
(b)射出成形によりコアにアイオノマー樹脂を主成分とするカバーを被覆してツーピースボールを製造した。
(c)圧縮成形によりコアにバラタを主成分とするカバーを被覆して糸巻きボールを製造した。
(d)射出成形によりポリブタジエンゴムを主成分とするツーピースボールのコアを製造した。
(e)射出成形によりポリブタジエンゴムを主成分とする糸巻きボールのソリッドコアを製造した。
【００２２】その結果、いずれの場合も良好な脱型性を示した。また、１００回ほど成形を繰り返した後、キャビティー表面のアモルファスカーボン硬質膜の状態を調べたところ、摩耗や腐食は生じておらず、アモルファスカーボン硬質膜の耐摩耗性、耐食性が良好であることが確認された。
【００２３】
【発明の効果】以上説明したように、本発明のゴルフボ

ール成形用金型は、脱型性、耐摩耗性、耐食性のいずれにも優れている。したがって、本発明の金型によれば、成形を行う毎に離型剤をスプレーしたり、内部離型剤を成形樹脂に練り込んだりする必要がなく、成形後にゴルフボールを洗浄して離型剤を除去するような必要もない。また、キャビティー面の耐摩耗性、耐食性に優れているため、長期間にわたってメンテナンスを行うことなく金型を使用することができる。

【図面の簡単な説明】

【図１】本発明に係るゴルフボール成形用金型の一実施例を示す部分拡大断面図である。

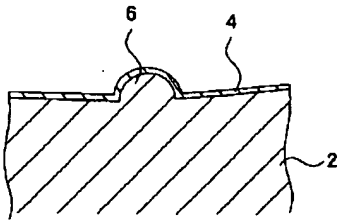
【符号の説明】

２　金型本体

４　アモルファスカーボン硬質膜からなる皮膜

６　ディンプル形成用凸部

【図１】



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